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UTAH'S COMPOSITE MATERIALS INDUSTRY

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In 1991, a study of Utah's composite materials industry was completed by the Bureau of Economic and Business Research for the Utah Division of Community and Economic Development. A synopsis of that study provides the basis for this review.

In this article, the terms "composite materials" and "advanced materials" are used interchangeably. These materials are generally classified as metals, ceramics or polymers which consist of fibers of one material held together by a matrix of a second material. Composites are designed in such a way that the fibers provide strength, stiffness, and fracture toughness and the matrix binds the fibers together in the proper orientation. The most common composite structures are ceramic composites (CMCs), polymer matrix composites (PMCs) and metal matrix composites (MMCs).

Materials within these categories are termed "advanced" if they exhibit properties (high temperature strength, or high stiffness per unit, for example) that are significantly better than those of conventional materials such as steel and aluminum.[1]

This analysis focuses on the advanced material component of these three broad sectors. Metal alloys, unreinforced plastics, and plastics reinforced with low-stiffness glass fibers have been excluded.

A Profile of Utah's Composite Materials Industry

Utah boasts a high concentration of well-established, experienced companies both developing and using composite materials. Utah is unique by virtue of the fact that both composite producers (companies which develop advanced composite materials) and custom shapers (companies which manufacture products from composite materials) are located in the state.

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[1] U.S. Congress, Office of Technology Assessment, Advanced Materials by Design, OTA-E-351 (Washington, D.C.: U.S. Government Printing Office, June 1988).

Structure of the Industry

Employment (May 1991)	2,123
Number of companies	27
Number of companies with more than 100 employees	9

Currently, 27 companies employing a total of 2,123 people are involved in either the development, manufacture, or production of advanced composite materials and shapes in Utah.[2] The majority of these companies are small; only nine firms employed more than 100 people in the first quarter of 1991.

Although composite materials represent a small component of the state's manufacturing base at the present time, it is a growing sector of the Utah economy. Over the past 15 months, employment at composite companies in Utah increased 9.1 percent, primarily in the area of PMC shaping.

While all three areas of advanced materials are represented in Utah's composite industry, the majority of composite companies utilize PMCs (equally distributed between carbon fibers and reinforced plastics) in their shaping activities (Table 1). Of the companies included in this study, only seven produce advanced materials which are used in the manufacture of end product. Three produce PMCs, two produce CMCs and two produce MMCs. Most companies are not in advanced material development or production, but rather, purchase the materials from producers located throughout the world.

In the area of PMCs, Utah has an especially high concentration of companies which manufacture products using filament winding techniques. This is a process in which fibers are coated with resins, wrapped around a mandrel, and then cured.

Hercules Aerospace, one of the largest participants in the user segment of the composites market in Utah, is also one of the largest producers of PAN-based carbon fibers and prepregs for worldwide consumption.[3,4]

Hercules is also the most vertically integrated composite company in Utah. It is both a large scale producer of composite materials and associated products, and a captive user (manufacturing products from composite materials for the end user market).

Other composite material developers include Ceramatec, Inc. (R&D of structural ceramics and CMCs); Norton Company (R&D facility); and VaporFab/Inco (R&D of nickel-coated fabric). Both Norton Company and VaporFab/Inco are R&D facilities that have yet to commercialize a product.

Suppliers

Approximately one-third of the companies which manufacture products from carbon fibers and prepregs purchase some of their materials locally from Hercules Aerospace. Other large suppliers of carbon fiber, prepregs, and fiberglass include: Ciba-Geigy (PAN fibers), Du Pont (Aramid fibers), Owens-Corning (Glass), ICI Fiberite (Prepregs), Erskine Johns (distributor), Fasco (distributor), and FiberChem (distributor). With the exception of Hercules Aerospace, none of these suppliers manufacture product in Utah. Base resin and epoxy suppliers include: Celanese; Ciba-Geigy; Dow Chemical; Shell; Amoco; and Erskine Johns. Again, none of these suppliers manufacture product in Utah.

Products and Customers

Composite materials companies in Utah manufacture an impressive array of products for many sectors of the U.S. economy. However, the main drivers for growth in the state's composite industry have been the military and aerospace sectors—both are especially heavy users of filament wound carbon fiber composites. At present, over half of Utah's composite material shapers produce products for one of these two sectors. However, many companies are reducing their dependence on military contracts and are looking for commercial applications.

Secondary uses include the manufacture of sports equipment and commercial aircraft. A sample of products manufactured by Utah composite material companies is shown on the following page. Table 2 shows the primary and secondary customers of these companies.

[2] This total includes companies which (1) produce composite materials, (2) manufacture products using composite materials, or (3) design industrial equipment or tooling processes used by composite companies. It does not include companies which sell fibers, prepregs, resins, and epoxies that are produced outside of Utah.

[3] PAN is the acronym for Polyacrylonitrile, the precursor for carbon fiber.

[4] Prepregs are fibers impregnated with resin.

Military/Aerospace Products
F-16 reconnaissance pods
C-17 transport doors
Composite chassis for military tanks
Rocket motor cases
Survivable external fuel tanks
Navy submersibles
Radar equipment/domes
Satellite antennae

Sports/Recreation
Golf shafts
Rafting oars
Softball bats
Ski poles
Skis
Amusement park rides
Playground equipment
Bicycle frames

Aircraft Components
Boeing aircraft waste tanks
Aircraft airframe
Rotor blades for helicopters
Camera radomes
Hydraulic and pneumatic cylinders
Boeing 747 honeycomb panel antenna
Antenna covers

Medical Products
Artificial graphite leg
Graphite knee brace
Prosthetic foot
In-grown toenail treatment
X-ray tables

Automotive Products
Automobile drive shafts
Monorail cars
Train modules
Gas tanks

Other
Industrial containers
Chemical tanks
Container dome covers
Polycrystalline products
Church steeples

Impediments to Growth

Nationally, consumption of advanced composites has been growing at an annual rate of 15 to 20 percent. Despite the fact that demand for composites has been steadily increasing over the past decade, significant barriers still exist to their widespread use, primarily the cost of raw material and manufacturing processes, market resistance, and a shortage of skilled engineers and technicians.

Expensive Manufacturing Processes

More than any other single barrier, the lack of reliable, low-cost fabrication processes inhibits the use of advanced materials in commercial applications. For example, many companies indicated they could reduce the price of the end item if they did their own prepregging. However, the expense of tooling up is prohibitive due to high machinery costs and the time-consuming nature of the prepregging process.

Furthermore, industry experts concede that technologies such as advanced ceramics and composites are still too new to warrant large scale investments in automation processes until these new materials and their properties are better understood.

Cost of Raw Materials

The potential for composites is huge but the cost of raw materials, especially carbon fibers and prepregs, is a major stumbling block in its widespread use. Although substantial declines in the price for raw materials have occurred over the past decade (reductions as high as 50 percent have been reported) the per-pound cost of composite materials is still prohibitive when compared to traditional materials used in mass produced consumer goods. In order for alternative uses to become feasible, the cost of fibers will need to parallel that of commonly used materials such as aluminum, steel, and wood. Industry experts agree that if a high-strength carbon fiber costing $3 to $5 per pound were available, major new opportunities would open up for use of composite materials in the automotive and construction industries.

Market Resistance

"If advanced materials are considered on a dollar-per-pound basis as replacements for steel or aluminum in existing designs, they cannot compete." This has often been the perception of potential user industries. However, per-pound costs and part-for-part replacement costs are not the only valid bases for comparisons between conventional and advanced materials. For example, advanced materials offer the opportunity to consolidate costs and reduce manufacturing and assembly costs. The problem lies in encouraging the user to adopt a long-term perspective, rather than a short-term, market-driven perspective.

Table 1
Characteristics of Utah's Composite Companies

	Composite Employment	Composite Producer	Composite Shaper	Date Founded
Polymer Matrix Composites				
Advanced Composites	17		X	1966
AeroTrans	75		X	1986
Applied Composites	20		X	1986
Arrow Dynamics	100		X	1981
Carbon Fiber Products	64		X	1985
Contour Composites	25		X	1980
CRP, dba Springlite	30		X	1983
Delta Reinforced Plastics	75		X	1981
EDO Fiber Science	135		X	1970
Evolution Ski	11		X	1985
Fiber Dynamics	4		X	1990
FiberTek	175		X	1978
Haelan	2		X	1990
Hercules Aerospace	175	X	X	1958
Leopete Technologies	17		X	1962
Mountain States Fiber	15		X	1973
Parker Packing	250	X	X	1967
Quality Composites	32		X	1985
R-Cubed Composites	35		X	1985
Thiokol, Inc.	250	X	X	1957
Totals	**1,507**	**3**	**20**	
Ceramic Matrix Composites				
Ceramatec, Inc.	110	X	X	1974
Norton Co.	30	X		1976
Totals	**140**	**2**	**1**	
Metal Matrix Composites				
Flameco	250	X	X	1968
Megadiamond	150		X	1966
VaporFab/Inco	5	X		1987
Totals	**405**	**2**	**2**	
Equipment/Processing Tech				
EnTec	60			1962
Radius Engineering	11			1985
Totals	**71**	**0**	**0**	

Table 2
Primary and Secondary Customers of Utah Composite Companies

Company	Military/ Aerospace	Commercial Aircraft	Sports/ Recreation	Medical Products	Automotive Industry	Other
Advanced Composites	X		m		m	
AeroTrans	X				X	
Applied Composites			X	X		
Arrow Dynamics	m		X			
Carbon Fiber			X			
Ceramatec, Inc.				X	X	
Contour Composites	m	X				
CRP (Springlite)			X	X		
Delta Plastics						X
EDO Fiber_Science	m	X				
Evolution Ski			X			
Fiber Dynamics					X	
Fibertek	X	m				
Flameco	X					
Haelen					X	
Hercules Aerospace	X					
Leopete Technologies	X	X				
Megadiamond						X
Mountain States Fiber			X			X
Norton Co.						X
Parker Packing	m	X				
Quality Composites	X		X			
R-Cubed Composites	X	X				
Thiokol	X					
VaporFab/Inco						X

X: Major Customer m: Secondary Customers

Source: Bureau of Economic and Business Research

Broader use of advanced materials will require changes in the attitudes of researchers and end users who are accustomed to designing structures and thinking in terms of more conventional materials.

Shortage of Skilled Labor

Some Utah companies have had difficulty finding engineers and technicians with adequate composite materials manufacturing experience. This problem has been somewhat alleviated with the creation of the Composite Materials Technology Program at the Salt Lake Community College. However, the availability of engineers who are knowledgeable in the area of advanced materials is limited.

Polymer Matrix Composites

Polymer Matrix Composites are usually defined as materials reinforced with continuous fibers, having properties comparable to high-stiffness glass or better, and using resins with properties comparable to epoxies or better. Usually excluded are E-glass reinforced polyester or vinylester matrices.[5]

PMCs are often divided into two groups: reinforced plastics, and "advanced composites". Reinforced plastics, which are relatively inexpensive, typically consist of polyester resins reinforced with low-stiffness glass fibers. They have been in use for approximately 30 to 40 years in applications such as boat hulls, corrugated sheet, pipe, automotive panels, and sporting goods.

Advanced composites, which have only been in use for approximately 15 to 20 years primarily in the aerospace industry, have superior strength and stiffness. The continuous reinforcing fibers of current use are glass, graphite (carbon), and Aramid. Other organic fibers, such as oriented polyethylene, are also becoming important. Of the continuous fibers, glass has a relatively low stiffness; however, its tensile strength is competitive with the other fibers and its cost is dramatically lower. Only when stiffness or weight are at a premium would Aramid and graphite fibers be used.

[5] Office of Technology Assessment.

Carbon fiber, derived from Polyacrylonitrile (PAN), reinforced with resin matrix, is by far the most commonly used nonfiberglass fiber composite in the advanced fiber composite industry. The greatest demand for carbon fibers comes from the aerospace industry. It is used extensively in aircraft wings and struts because it adds strength and stiffness while eliminating weight. Sports equipment manufacturers have also found different uses for carbon fibers incorporating them into tennis racket frames and golf club shafts.

Another important advanced fiber composite is Aramid fiber (KEVLAR), for which Du Pont holds the patent. Aramid fibers, accounting for over 20 percent of all production, are used chiefly for reinforcing rubber products; and to a lesser degree, for structural reinforcement in aircraft and space hardware. Specialized fibers such as boron, ceramic, and other polymers account for the remainder.

Market Size and Demand

Data provided by the Suppliers of Advanced Materials Association (SACMA) show that almost $1 billion worth of fibers and prepregs were shipped worldwide during 1989. Aerospace usage continued to account for the majority of industry shipments, followed by sports, marine and recreational uses. Table 3 shows the semi-annual shipment data for 1990 compared to annual shipment data for the preceding five-year period.

SACMA/ETAC estimates that its statistics, which are drawn from actual member company data, represent over 90 percent of the shipments of advanced composite fibers and prepregs within North America, Western Europe, and the Far East. These figures do not include prepreg composites utilized for circuit board applications, or fibers and prepregs produced and converted to finished parts within member companies, i.e., fibers and prepregs manufactured and used by Hercules in its own production activities.

Information on total production (fibers and prepregs produced in-house and used for constructing composite structures, and fibers and prepregs sold to non-fiber producing companies) is incomplete. However, estimates provided by a contractor report prepared for the Office of Trade Administration indicates that production value in 1985 was approx-

imately $2.1 billion divided as follows: U.S., $1.3 billion; Western Europe, $600 million; and Japan, $200 million.

In the U.S., PMC development has been driven by military and space programs; whereas development in Western Europe is keyed more heavily toward commercial aircraft. The Japanese market is dominated by sporting goods applications.

Demand for PMCs is strong. Consumption estimates for polymer composites show a relatively high growth rate of 15 to 22 percent per year over the next few decades. By 1995, consumption is forecast to be approximately 50 million kilograms valued at $6.5 billion (1985 dollars). By the year 2000, consumption is forecast to be 90 million kilograms valued at about $12 billion.[6]

Utah PMC Producers

Three companies in Utah currently produce and/or develop advanced PMCs: Hercules Aerospace, Thiokol, and Parker Packing. Of the three, Hercules is the only large scale producer. Hercules was an early entrant in the fiber marketplace, and is the single largest U.S. supplier, accounting for over one-third of all carbon fibers supplied by U.S. companies. It is also one of the largest domestic producers of prepregs, and the only Utah company producing and selling prepregs on the open market.

Other Utah companies have developed in-house capabilities for prepregging, but produce for their own manufacturing activities. If financing is arranged, Parker Packing plans to develop thermally-conductive polymers and encapsulation materials. Thiokol is in the process of developing new resin systems, and evaluating a recently developed fiber.

Utah PMC Users

Twenty-one companies, employing over 1,500 people in Utah, use advanced composites in their manufacturing processes. Over half manufacture products for military/aerospace applications. Most of the composites work performed at two of the largest firms (Hercules Aerospace and Thiokol, Inc.) is for this sector exclusively. Advanced Composites, AeroTrans, FiberTek, Leopete Technologies, Quality Composites, and R-Cubed Composites also consider defense and aerospace uses to be primary markets.

Manufacturing products for the recreational market is another important use of composite materials in Utah. Arrow Dynamics designed and built many of the original rides at Disneyland and Disney World, and is the world leader in the custom design of amusement park rides.

The world famous Evolution Skis are manufactured by Evolution, a home-grown Utah company. Evolution manufactures a variety of hand-crafted, custom composite-based skis.

Table 3
Worldwide Shipments of Advanced Composites
1985 through June 1990

Year	FIBERS		PREPREGS	
	Kilograms	U.S. Dollars	Kilograms	U.S. Dollars
1985	5,278,695	$312,970,000	6,993,164	$301,790,000
1986	5,949,489	355,630,000	8,219,274	385,670,000
1987	6,830,359	397,790,000	8,888,224	452,420,000
1988	8,113,806	498,650,000	10,278,340	498,600,000
1989	8,940,858	397,490,000	12,029,233	586,210,000
1990a	4,881,260	230,820,000	6,734,452	336,430,000

[a]1990 figures represent shipment from January 1990 through June 1990.
Source: Suppliers of Advanced Composite Materials Association and the European Trade Association of Advanced Composite Materials Suppliers.

[6] Office of Technology Assessment.

Contour Composites, EDO Fiber Science, Leopete Technologies, Parker Packing, and R-Cubed Composites all look to the commercial aircraft sector for their primary customers. These companies manufacture a variety of components that are used in commercial aircraft and helicopters.

Unique products manufactured in Utah for use in the medical industry include a new in-grown toenail treatment called "NailEze"; a system developed by Haelen which utilizes a thin strip of graphite that is bonded to the rounded surface of an ingrown toenail. A graphite epoxy artificial leg and knee braces are manufactured by Applied Composites. CRP designs and manufactures a carbon fiber prosthetic foot.

Fiber Dynamics, a newcomer to the Utah composite industry, has a contract with the Gas Research Institute to design compressed natural gas cylinders for automobiles using natural gas as fuel.

Ceramic Matrix Composites

The area of Ceramic Matrix Composites is a small, but growing subset of the Advanced Ceramics Group. Advanced ceramics are made by consolidating pure microscopic powders at high temperatures. Based on oxides, nitrites, and carbides of silicon, aluminum, titanium and zirconium, advanced ceramics can be used in environments which are too demanding for traditional metals, plastics, or conventional ceramics.

Compared with metals, ceramics are unsurpassed in their high temperature and abrasion resistance properties and chemical stability. However, they also have lower thermal conductivity, thermal expansion and lower toughness—that is, they tend to be brittle. This brittleness causes them to fail suddenly when the applied stress is sufficient to cause cracks that originate as microscopic flaws in the material.

There are several ways to reduce the sensitivity of ceramics to flaws. One is the development of a ceramic matrix composite (CMC). This process incorporates ceramic particulates, whiskers, or continuous fibers in an ceramic matrix. The potential benefits of ceramic composites include increased fracture toughness, high hardness, and improved thermal shock resistance. Fabrication of CMCs reinforced with continuous fiber is very expensive. Considerable R&D will be necessary to optimize fabrication and to decrease the cost to levels that are acceptable for most commercial applications.

Market Size and Demand

The market for CMCs reached $131 million in 1990, with oxides accounting for about 62 percent. The market is expected to grow about 15 percent annually, reaching $249.2 million by 1995, and $509 million in 2000. In terms of volume, the 1990 consumption is expected to be 227,000 kilograms, almost doubling by 1995 (412,500 kilograms). Further growth is expected throughout the rest of the decade, when consumption is projected to reach 816,500 kilograms by the year 2000.[7] Table 4 shows the demand for CMCs by end market.

Table 4
U. S. Ceramic Matrix Composite Market

	Millions of Dollars			AAGR
Sector	1990	1995	2000	(%)
Cutting Tools	32.0	57.5	104.0	12.5
Wear Parts	53.5	119.5	272.0	24.5
Aerospace and Military	34.5	47.0	67.0	6.9
Energy-related and industrial applications	6.7	11.2	19.0	10.9
Engines	4.0	14.0	47.0	28.0
Total	130.7	249.2	509.0	14.6

Note: AAGR = Average Annual Growth Rate.
Source: Ceramic Matrix Composites, Business Communications, Co., Inc., Norwalk, CT.

Oxide matrix composites will continue to dominate the market over the course of the next ten years. This is primarily due to the high volume zirconia composites used for wear parts and alumina cutting tool inserts.

Utah CMC Producers and Users

Ceramatec and Norton Company are both involved in the development of CMCs. Ceramatec has been pursuing development of advanced ceramic materials for much of the past decade. Until recently, the company's emphasis has been limited

[7] Materials Processing Report, 1990 Elsevier Publishing Co., Inc. (November 1990).

to R&D of structural ceramics, and experimentation with various methods of embedding carbon fibers in ceramic materials. The company is now pursuing commercial applications for its technology, and is manufacturing oxygen analyzers.

Norton Company is the R&D facility for a parent company which produces ceramic powders, bearings, filters, armor, and cutting tools. The Utah facility conducts R&D in the area of new materials and uses for cutting tools.

Metal Matrix Composites

Metal Matrix Composites (MMCs) usually consist of metals and metal alloys reinforced with fibers, whiskers, or particulates, and wires. Compared with unreinforced metals, MMCs offer higher specific strength and stiffness, higher operating temperature, and greater wear resistance. MMCs cost much more than monolithic metals and are therefore used only in such high-performance applications as military products and aerospace.

Three Utah companies (VaporFab/Inco, Flameco, and Megadiamond) are involved in some aspect of MMC development. VaporFab/Inco is a small R&D facility in Utah which develops nickel-coated fibers and fabrics. Flameco manufactures aircraft airframes and engines from composite metals such as titanium, aluminum, hastalloy, inconel, stainless steel and heat-resistant alloys. Flameco also engages in development work on metal matrix composites, tialuminides and aluminum lithium, on a limited basis. Flameco's commercial products include engines for General Electric, titanium components for the Douglas MD-11, and assemblies for Boeing 737, 747, and 767 aircraft.

Megadiamond manufactures polycrystalline diamond products used in drilling applications and cutting tool applications. A layer of fine diamond particulates is bonded to a tungsten carbide substrate to form a highly effective cutting tool.

Market Size and Demand

At present, metal matrix composites remain primarily materials of military interest in the U. S. because only the Department of Defense's high performance specifications have justified the materials' cost. Future commercial markets for MMCs remain uncertain for two reasons. First, their physical and mechanical properties rarely exceed those of PMCs or CMCs. Second, MMCs tend to cluster around two types: Type I consists of high-performance composites reinforced with expensive fibers and requiring expensive processing methods. The other consists of low-cost, low-performance composites reinforced with inexpensive particulates and fibers. The cost of Type I is too high for any application but military or aerospace. The cost/benefit advantages of Type II MMC over traditional metal alloys remains in doubt.

Conclusion

The demand for structures made of composite materials will continue its rapid ascent, especially as efficient, cost-effective processes that will allow large-scale manufacturing are developed, and the use of composite materials gains wider acceptance by design engineers.

While all areas of composite materials show promise, the PMC market holds the highest potential, and Utah companies appear to be well-positioned to take advantage of the growing demand for PMC-based products.

Utah has an impressive concentration of well-established, experienced companies which both produce PMCs and structures manufactured from PMC materials. (Of special note is the number of companies with filament winding capability and expertise.) Utah-based PMC companies manufacture a broad range of products for all segments of the end-user market (military, industrial, and commercial). Finally, while finding skilled labor remains a challenge, the presence of Hercules, a major PMC producer, has produced a solid labor pool of polymer composite technologists, and the availabilty of trained composite technicians is generally good as a result of educational programs underway at area community colleges.

With respect to large-scale production of CMC- and MMC-based products, further technological advances are needed. However, there are a handful of companies in Utah which have gained world-wide recognition in the development and use of these advanced materials at both the production and manufacturing stages.

Utah Business Statistics

UTAH DATA	Apr. 1990	Apr. 1991	% Change from Year Ago	12-Month Average This Year	12-Month Average Last Year	12-Month Average % Change
Total Personal Income (seasonally adjusted) (mil. of dol.) (qtly.)	24,041	NA	NA	NA	22,963	NA
New Corporations (no.)	501	492	-1.8%	504	483	4.3%
New Car, Truck, and Motor Home Sales (no.)	5,173	NA	NA	NA	4,984	NA
Agriculture						
Average Prices Recorded by Farmers (dol.)						
Beef Steers and Heifers (cwt) (thous.)	78.60	78.80	0.3%	77.10	73.55	4.8%
Lambs (cwt)	51.30	42.30	-17.5%	44.59	58.08	-23.2%
Milk Wholesale (cwt)	12.60	10.30	-18.3%	11.93	13.12	-9.0%
Alfalfa Hay, Baled (per ton)	86.00	69.00	-19.8%	81.08	84.75	-4.3%
Cattle Slaughtered (live weight) (thous. of lbs.)	43,841	47,517	8.4%	46,822	47,527	-1.5%
Construction						
Total Construction (thous. of dol.) 1	87,542.2	110,229.4	25.9%	87,235.1	78,329.9	11.4%
Residential	45,966.6	71,029.7	54.5%	46,981.7	39,097.1	20.2%
Nonresidential	25,462.8	30,657.4	20.4%	27,627.1	23,481.0	17.7%
Additions, Alterations, and Conversions	16,112.7	8,542.3	-47.0%	12,626.3	15,751.9	-19.8%
Total Permit Construction (thous. of dol.) 2	107,480.3	123,091.7	14.5%	107,135.8	84,698.0	26.5%
Residential	49,810.4	79,644.7	59.9%	51,973.4	40,434.6	28.5%
Nonresidential	38,370.2	34,340.7	-10.5%	35,525.4	29,952.9	18.6%
Additions, Alterations, and Repairs	19,299.7	9,106.3	-52.8%	19,637.0	14,310.5	37.2%
New Dwelling Units (no.)	631	948	50.2%	618	505	22.5%
Employment						
Civilian Labor Force (thous.)	779.6	806.3	3.4%	799.7	793.5	0.8%
Total Employed Persons	740.7	769.2	3.8%	764.0	757.8	0.8%
Unemployed Persons	38.9	37.1	-4.6%	35.6	35.7	-0.1%
Percent Total Labor Force	5.0	4.6	-8.0%	4.5	4.5	-1.5%
Employees on Nonagricultural Payrolls (thous. of jobs)	715.2	744.8	4.1%	733.7	702.2	4.5%
Manufacturing	105.2	108.0	2.7%	107.6	104.4	3.1%
Mining	8.4	8.7	3.6%	8.7	8.3	4.3%
Contract Construction	25.7	27.9	8.6%	27.9	26.4	5.6%
Transportation, Communication, and Utilities	41.8	42.5	1.7%	42.9	41.4	3.6%
Wholesale Trade	37.7	38.9	3.2%	39.6	38.4	3.1%
Retail Trade	130.2	134.6	3.4%	136.9	130.1	5.2%
Finance, Insurance, and Real Estate	33.9	34.8	2.7%	34.5	33.6	2.7%
Services 3	178.5	192.4	7.8%	184.4	171.7	7.4%
Federal Government	41.1	40.1	-2.4%	39.3	40.2	-2.2%
State Government 4	42.3	43.9	3.8%	42.3	40.7	3.8%
Local Government 4	70.5	73.0	3.5%	69.4	67.0	3.7%
Average Weekly Hours						
Manufacturing	39.2	39.6	1.0%	39.8	39.9	-0.4%
Mining	42.9	44.5	3.7%	44.4	41.5	7.1%
Wholesale Trade	37.9	37.0	-2.4%	37.7	37.1	1.4%
Retail Trade	26.5	26.2	-1.1%	26.6	27.1	-2.1%
Amount of Unemployment Compensation (thous. of dol.)	5,334.5	7,370.2	38.2%	5,350.6	4,919.0	8.8%
Finance						
Savings, Savings and Loan Association (mil. of dol.)	1,856.5	868.5	-53.2%	NA	2,076.5	NA
Tax Collections by the State of Utah (thous. of dol.)						
Total Tax Collections	385,489.7	NA	NA	NA	178,558.3	NA
Sales and Use Tax	158,215.0	NA	NA	NA	69,201.8	NA
Motor Fuel Tax	10,488.1	NA	NA	NA	11,720.5	NA
Individual Income Tax	129,618.7	NA	NA	NA	56,051.2	NA
Corporation Franchise Tax	21,954.8	NA	NA	NA	4,623.4	NA
Production						
Crude Oil to Refineries (thous. of bbls.)	3,414.8	3,608.3	5.7%	3,658.2	3,643.4	0.4%
Crude Oil (thous. of bbls.)	2,285.4	2,206.9	-3.4%	2,248.5	2,335.4	-3.7%
Natural Gas (mil. of cu. ft.)	23,773.5	27,429.6	15.4%	27,514.9	23,701.7	16.1%
Coal (thous. short tons)	1,794.0	2,013.0	12.2%	1,859.2	1,791.2	3.3%
Tourism/Travel						
Air Passengers (total no. on and off)(S.L. Int'l. Airport)	887,484	934,408	5.3%	1,002,967	1,004,423	-0.1%
Highway Traffic Count Across State Lines	43,866	45,582	3.9%	44,894	42,113	6.6%
Transient Room Tax (thous. of dol.)	1,036.3	NA	NA	NA	634.9	NA
Visits, State, Nat'l. Parks, Monuments (thous.)	1,051.6	867.2	-17.5%	1,107.1	1,126.0	-1.7%
Utilities						
Telephone Lines in Service (Mt. Bell)(Residential)	511,098	532,114	4.1%	523,802	505,244	3.7%
Telephone Lines in Service (Mt. Bell)(Nonresidential)	192,610	202,631	5.2%	198,666	188,221	5.5%
Electric Customers (Residential)	489,155	NA	NA	NA	486,031	NA
Electric Customers (Commercial)	49,872	NA	NA	NA	48,815	NA
Natural Gas Customers (Residential & Commercial)	487,876	497,906	2.1%	490,459	477,804	2.6%
Natural Gas Customers (Industrial)	569	585	2.8%	578	567	1.8%

Utah Business Statistics

UTAH DATA	Apr. 1990	Apr. 1991	% Change from Year Ago	12-Month Average This Year	12-Month Average Last Year	12-Month Average % Change
Davis County						
Non-Ag. Employment (thous.)	58.9r	61.2	3.9%	60.3	57.8	4.4%
Unemployment Rate	3.9r	3.7	-5.1%	4.3	4.2	3.6%
Auth. Permit Construction (thous. of dol.)	9,944.8	14,755.6	48.4%	11,777.0	10,575.5	11.4%
New Dwelling Units (no.)	88	109	23.9%	79	75	5.9%
Postal Receipts (thous. of dol.)	560.4	736.1	31.4%	669.3	642.1	4.2%
Electric Customers (Residential)	49,741	50,627	1.8%	50,262	49,414	1.7%
Electric Customers (Commercial)	3,636	3,841	5.6%	3,723	3,650	2.0%
Natural Gas Customers (Residential)	53,073	54,126	2.0%	53,381	52,197	2.3%
Natural Gas Customers (Industrial)	56	56	0.0%	57	56	1.2%
Telephone Lines in Service (Mt. Bell)(Residential)	59,894	62,107	3.7%	61,110	58,058	5.3%
Telephone Lines in Service (Mt. Bell)(Nonresidential)	12,679	13,019	2.7%	13,034	12,264	6.3%
Salt Lake County						
Non-Ag. Employment (thous.)	363.0r	375.5	3.4%	373.2	357.8	4.3%
Unemployment Rate	4.0r	3.4	-15.0%	3.9	4.0	-3.1%
Auth. Permit Construction (thous. of dol.)	46,623.7	45,974.9	-1.4%	47,850.4	35,677.8	34.1%
New Dwelling Units (no.)	276	355	28.6%	208	180	15.2%
Postal Receipts (thous. of dol.)	8,012.6	8,900.1	11.1%	8,131.4	8,140.2	-0.1%
Electric Customers (Residential)	245,843	249,390	1.4%	247,789	244,234	1.5%
Electric Customers (Commercial)	21,169	21,520	1.7%	21,264	21,008	1.2%
Natural Gas Customers (Residential)	229,399	232,669	1.4%	229,992	225,906	1.8%
Natural Gas Customers (Industrial)	244	250	2.5%	247	245	0.6%
Telephone Lines in Service (Mt. Bell)(Residential)	241,203	250,622	3.9%	246,653	237,712	3.8%
Telephone Lines in Service (Mt. Bell)(Nonresidential)	116,957	122,654	4.9%	120,203	114,371	5.1%
Utah County						
Non-Ag. Employment (thous.)	92.9r	100.7	8.4%	95.6	89.3	7.1%
Unemployment Rate	3.5r	3.5	0.0%	3.9	4.0	-3.9%
Auth. Permit Construction (thous. of dol.)	17,311.7	30,723.0	77.5%	18,490.0	12,473.5	48.2%
New Dwelling Units (no.)	89	170	91.0%	115	79	45.6%
Postal Receipts (thous. of dol.)	1,863.2	1,993.9	7.0%	1,738.5	1,568.6	10.8%
Electric Customers (Residential)	53,448	56,284	5.3%	54,765	53,301	2.7%
Electric Customers (Commercial)	7,284	6,855	-5.9%	6,926	6,592	5.1%
Natural Gas Customers (Residential)	64,886	66,558	2.6%	65,129	63,528	2.5%
Natural Gas Customers (Industrial)	74	80	8.1%	75	73	1.9%
Telephone Lines in Service (Mt. Bell)(Residential)	65,412	68,354	4.5%	67,924	66,326	2.4%
Telephone Lines in Service (Mt. Bell)(Nonresidential)	20,637	21,961	6.4%	21,485	20,499	4.8%
Weber County						
Non-Ag. Employment (thous.)	66.5r	69.0	3.8%	67.1	64.6	3.9%
Unemployment Rate	5.0r	4.7	-6.0%	5.6	5.4	4.5%
Auth. Permit Construction (thous. of dol.)	4,739.3	7,662.1	61.7%	6,251.2	6,453.8	-3.1%
New Dwelling Units (no.)	34	70	105.9%	42	44	-5.3%
Postal Receipts (thous. of dol.)	691.9	828.5	19.7%	751.1	702.9	6.9%
Electric Customers (Residential)	54,752	55,430	1.2%	55,145	54,401	1.4%
Electric Customers (Commercial)	5,135	5,193	1.1%	5,153	5,048	2.1%
Natural Gas Customers (Residential)	51,688	51,990	0.6%	51,616	50,813	1.6%
Natural Gas Customers (Industrial)	83	76	-8.4%	81	84	-4.1%
Telephone Lines in Service (Mt. Bell)(Residential)	46,806	48,163	2.9%	47,511	47,254	0.5%
Telephone Lines in Service (Mt. Bell)(Nonresidential)	13,150	13,600	3.4%	13,365	12,573	6.3%

1 Obtained from U.S. Bureau of the Census Construction Statistics Division.
2 Obtained from *Utah Construction Report*.
3 Includes services by nonprofit and religious organizations.
4 Includes public schools and college institutions.

NA Not Available
r Revised

Sources:

Personal Income	U.S. Department of Commerce, Bureau of Economic Analysis.
New Corporations	Utah Secretary of State.
New Car and Truck Sales	Utah State Tax Commission, Economic and Statistical Unit.
Agriculture	U.S. Department of Agriculture, Utah Agricultural Statistics Service, *Utah Agriculture*.
Construction Data	U.S. Bureau of the Census and Bureau of Economic and Business Research, *Utah Construction Report*.
Employment Data	Utah Department of Employment Security.
Savings Information	Utah Savings and Loan Institutions.
Tax Collections	Utah State Tax Commission.
Crude Oil Production	Utah Department of Oil, Gas, and Mining and Area Oil Refineries.
Natural Gas Production	Utah Department of Oil, Gas, and Mining.
Coal Production	U.S. Department of Energy.
Air Passengers	Salt Lake City International Airport, Statistics Division.
Highway Traffic Count	Utah Department of Transportation.
Visits to State and National Parks and Monuments	U.S. Forest Service, Utah State Parks and Recreation Department.
Utilities Data	Cooperating Utah Utility Companies.
Postal Receipts	Postmasters in Davis, Salt Lake, Utah, and Weber Counties.

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NATIONAL DATA	Apr. 1990	Apr. 1991	% Change from Year Ago	12-Month Average This Year	12-Month Average Last Year	12-Month Average % Change
U.S. Gross National Product (seasonally adjusted) (bil.) (qtly.)	5,443.3	NA	NA	NA	5,291.8	NA
Total Personal Income (seasonally adjusted) (bil. of dol.)	4,604.5	4,755.1	3.3%	4,701.3	4,469.9	5.2%
Industrial Production Indexes (seasonally adjusted) (1987=100)	108.8	105.3	-3.2%	108.3	108.3	0.0%
New Plant and Equipment Expenditures by Business (bil.) (qtly.)	535.5	544.2	1.6%	534.4	520.1	2.8%
Net Exports of Goods and Services (bil.) (qtly.)	-24.9	NA	NA	NA	-39.3	NA
Exports of Goods and Services (bil.) (qtly.)	659.7	NA	NA	NA	641.7	NA
Imports of Goods and Services (bil.) (qtly.)	684.6	NA	NA	NA	681.0	NA
Index of Leading Indicators (1982=100)	145.2	142.0	-2.2%	142.4	144.7	-1.6%
Price Indexes						
Consumer Price Indexes (not seasonally adjusted) (1982-84=100)						
CPI-U (All Urban Consumers) All Items	128.9	135.2	4.9%	132.9	126.0	5.4%
CPI-U (All Urban Consumers) Food & Beverages	131.0	137.2	4.7%	133.9	127.5	5.1%
CPI-U (All Urban Consumers) Housing	126.8	132.5	4.5%	130.5	124.7	4.6%
CPI-U (All Urban Consumers) Transportation	117.3	122.2	4.2%	122.6	115.7	6.0%
CPI-U (All Urban Consumers) Medical Care	159.8	174.4	9.1%	167.8	153.4	9.4%
CPI-U (All Urban Consumers) Energy	95.7	99.5	4.0%	104.1	96.1	8.3%
Producer Price Index (not seasonally adjusted) (1982=100)						
Producer Price Index, All Finished Goods	117.0	120.9	3.3%	120.4	115.2	4.5%
GNP Price Deflator (1982=100) (qtly.)	131.0	NA	NA	NA	128.0	NA
Civilian Employment (seasonally adjusted)						
Total Civilian Labor Force (mil.)	124.8	125.7	0.7%	125.0	124.3	0.5%
Total Civilian Employment (mil.)	118.1	117.4	-0.6%	117.6	117.7	-0.1%
Unemployment Rate	5.4	6.6	22.2%	5.9	5.3	11.9%
Construction						
Total Construction (mil. of dol.)	21,195.0	20,929.0	-1.3%	18,630.9	22,274.9	-16.4%
Residential	9,932.0	8,712.0	-12.3%	8,024.6	10,046.3	-20.1%
Nonresidential	7,238.0	7,076.0	-2.2%	6,684.2	8,202.6	-18.5%
Non-Building	4,025.0	5,141.0	27.7%	3,922.1	4,025.9	-2.6%
New Dwelling Units (no.)	107,947	88,098	-18.4%	84,588	111,288	-24.0%
Interest Rates						
Federal Funds Rate	8.26	5.91	-28.5%	7.45	8.79	-15.2%
Short Term (3-month Treasury bill rate)	7.78	5.67	-27.1%	6.91	7.85	-11.9%
Long Term (30-year Treasury bond yields)	8.92	8.29	-7.1%	8.60	8.42	2.2%
Prime Rates Charged by Banks on Short-term Business Loans (avg.)	10.00	9.00	-10.0%	9.71	10.51	-7.6%
Mortgage Rates (new homes)	9.83	9.24	-6.0%	9.55	9.80	-2.6%

Sources: *Survey of Current Business*, U.S. Department of Commerce: U.S. Gross National Product, Total Personal Income, Industrial Production Indexes, New Plant and Equipment Expenditures by Business, Export/Import Data, Index of Leading Indicators, GNP Price Deflator, National Employment Data, Interest Rates.

F.W. Dodge Report, McGraw-Hill: National Construction Data.

Monthly Labor Review, U.S. Department of Labor, Bureau of Labor Statistics: Consumer Price Indexes, Producer Price Index.

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